REMARKS

Applicant's counsel thanks Examiner Cooney for his continued careful and thorough examination of the present application.

Claims 10 and 23 have been amended to more clearly describe the invention, and new claims 33-40 have been added. No new matter has been entered; basis for the new claims can be found in the specification, e.g., as follows:

Claim	Basis
33	Para. [0020]
34,39	Paras. [0022]-[0023]
35,38	Table 1
36	Para. [0034]
37	Para. [0029], Table 1
40	Examples, Figs. 1-12 and Table 3

Independent claims 1, 2, 15, 16 and 32 all stand rejected under 35 USC § 103(a) as being obvious over each of Apichatachutapan, Lutter and Falke. Each of these independent claims recites a foam (or method of making it) that **1)** comprises (or employs) a significant amount of propylene oxide (PO) extended amine-based polyether polyol, and **2)** is (or produces) a "semi-rigid" viscoelastic foam. Regarding the first point, the Examiner's position is that propylene oxide extension and tipping refers only to the "growth" of the polyols from the respective initiators and therefore does not distinguish the references, implying that no consequent structure is conveyed by this limitation. Regarding the second point, the Examiner has held that no weight is to be accorded the 'semi-rigid' limitation in a "patentable sense." See Office action, e.g., at page 3. Each of the foregoing contentions by the Examiner is respectfully traversed for the reasons described below, where the art rejections are discussed in conjunction with the enclosed Declaration of Charles M. Milliren, Ph.D ("Milliren Declaration"). As will

become evident, when the foregoing limitations are accorded appropriate patentable weight, the claims are not obvious in view of any of the cited references.

Each of the independent claims is directed to a foam that is both *semi-rigid* and *viscoelastic*, and which comprises or is made by combining a propylene oxide extended amine-based polyol (or a mixture of such polyols) and other filled and/or unfilled polyols. None of the cited references remotely suggests the preparation of a *semi-rigid* viscoelastic foam from a mixture of polyols containing the propylene oxide extended amine-based polyol(s) as claimed. To recognize this it is important first to recognize that, contrary to the Examiner's assertion, "semi-rigid" is a structural limitation in the patentable sense that must be accorded patentable weight.

In his enclosed declaration, Dr. Milliren explains in detail the meaning of the term "semi-rigid" in the foam art, and describes the structural significance of this term. Specifically, following a discussion of the behavioral qualities of foams, Dr. Milliren summarizes as follows:

> [A] "semi-rigid" foam resists deflection from an external load to a significant degree comparable to rigid foams (e.g. EPS), but nevertheless can be nondestructively deflected and will recover following such deflection commensurate with the foam's relative elasticity (unlike a rigid foam which would be destructively deflected or crushed and could not recover). The foregoing is a qualitative physical property of the foam based on its chemical make-up and the resulting structure and morphology. This property cannot otherwise effectively be described, for example based on the precise physico-chemical structure that produces the observed behavior, *because the precise structure of a foam defies explicit characterization through conventional techniques*. Foams are extremely complex materials characterized by a very complex cross-linking structure, cellular structure, solid porosity, and other structure-contributing factors that cannot be readily quantified or observed. Thus, the physical structure of foams typically is classified using terms describing their behavioral characteristics as described [in the Milliren Declaration], and "semi-rigid" is one of

> those terms. "Semi-rigid" is a structural limitation because it describes by necessary implication *otherwise uncharacterizable aspects of physical structure which are responsible for imparting the "semi-rigid" properties to the foam* as previously described.

Milliren Declaration, ¶ 17 (emphasis supplied).

Hence, the term "semi-rigid" is essential to an appropriate characterization of the foams as claimed because this term conveys information regarding the foam's structure that cannot otherwise be described. It is entirely proper to claim the structure of an invention in qualitative or "functional" language, and such language covers the structure implied by the employed terms. See MPEP § 2114. This is especially important when, as here, the structure of the foam otherwise cannot be defined. The patentee is no less entitled to his invention simply because the exact structure cannot be empirically defined, and it is improper to say that the term "semi-rigid" does not convey a limitation in the "patentable sense," especially when there is no more exact way to describe the physico-chemical structure that produces the observed behavior. For a more detailed discussion supporting the structural significance of "semi-rigid" in the claims, see the Milliren Declaration at ¶¶ 11-17. In his declaration, Dr. Milliren also presents a general overview of viscoelasticity for the Examiner's convenience and information, in order to assist the Examiner to understand the structural significance of the term "semi-rigid viscoelastic foam" in a complete context.

Once the term "semi-rigid" is accorded the appropriate patentable weight, it is clear that none of the references either suggests the preparation of a foam as claimed, or implies any reasonable expectation of success for doing so.

Turning first to Apichatachutapan, that reference is concerned primarily with preparing a flame-retardant foam that has no separate flame retardant additives. See

para. [0002] and rest of specification. This reference, like most patents in the field, recites long laundry lists of potential candidates of every kind and description for the various components that can go into polyurethane foams, e.g., polyols, their initiators, hydroxyl numbers, molecular weights, extension species, isocyanates, catalysts, chain extenders, etc., with no regard to whether, how or why one would, should or even could prepare a polyurethane foam from every possible combination of all these components for all possible concentrations of each component to achieve any particular result.

Nothing in Apichatachutapan fairly or even remotely suggests preparing a *semi-rigid* viscoelastic foam, particularly one made using the proportions of amine-based polyols, particularly propylene oxide extended amine-based polyols, as claimed. Contrary to the Examiner's assertion regarding this latter limitation, propylene oxide extension refers not only to the "growth process" for the polyol as the Examiner has indicated, *but also* to the resulting polyol's structure. That is, an amine-based polyol that is grown using propylene oxide extension units will incorporate structure composed of polypropylene oxide chains as is well understood in the art. This conventionally is referred to in the art as propylene oxide (or polyoxypropylene) extension, and the corresponding limitations in the claims are indicative of structure entitled to patentable weight.

Moreover, as evidenced by the examples in Apichatachutapan as explained in the Milliren Declaration, the foams made in that reference are flexible foams. Starting from Apichatachutapan, one would not have been motivated, nor would he have expected to achieve a successful result, to prepare a semi-rigid viscoelastic foam from a polyol composition comprising amounts of amine-based polyols as claimed, and

particularly propylene oxide extended tipped amine-based polyols. The fact that Apichatachutapan mentions the use of amine-based initiators at all is the result of mere laundry listing of virtually every conceivable initiator molecule that ever has been or possibly might be used to make virtually any polyurethane foam, with no regard whatsoever to if, how or when such amine initiators are, can or should be used. In fact, as explained in the Milliren Declaration at ¶ 24, amine-based initiators typically are used for rigid foams, and not for flexible foams which are the focus of Apichatachutapan, and nothing in that reference fairly suggests their use to prepare a semi-rigid viscoelastic foam as presently claimed. It is noteworthy that none of the examples in Apichatachutapan utilizes an amine-based initiator molecule in any polyol.

The lack of any motivation from Apichatachutapan (or of any reasonable expectation of success) is further emphasized by the extremely surprising and unexpected results obtained for the semi-rigid viscoelastic foams in the application. As explained by Dr. Milliren:

> The present invention is based on the extremely surprising result that the combination of a substantial amount of an amine-based polyether polyol, or a mixture of such polyols, that is/are propylene oxide extended, together with at least one other filled and/or unfilled polyether polyol and an appropriate amount of isocyanate as well as with other component(s) as claimed, produces a semi-rigid viscoelastic foam that has proven very effective to attenuate impact force across a very wide range of dynamic impact speeds; e.g. ranging from 2-6 meters per second, or broader. This result was particularly surprising because amine-based polyols are usually considered to be ***rigid*** foam precursors, and it was quite surprising that the use of such polyols, in relatively significant amounts with other polyols, would produce such effective ***semi-rigid*** foams that are so well suited to dynamic impact energy attenuation applications, yet still recover following an impact. Even more surprising was the breadth of impact speeds over which impact force could be effectively attenuated

> using these foams compared to a conventional rigid foam such as EPS.

Milliren Declaration, ¶ 24.

As Dr. Milliren further points out in his declaration at ¶¶ 25-27, the Examples in the present application present a substantial amount of data comparing the present foam to conventional rigid polystyrene, and demonstrating the foam's surprising and unexpected effectiveness to attenuate dynamic impact forces across a broad range of impact speeds, including comparable or even better performance than rigid polystyrene for high velocity (6.23 m/s) impacts. See table 3 and Figs. 1-12 for comparative data. That a semi-rigid foam **1)** could be prepared using propylene oxide extended tipped amine-based polyols, and **2)** would be so effective to attenuate even high velocity impacts despite being a semi-rigid and not a rigid foam, was a highly surprising and unexpected result that does not directly follow from anything disclosed in Apichatachutapan.

The same reasoning as above is applicable with equal force against the rejections over both Falke and Lutter. Both these references are directed, explicitly, to flexible foams (Lutter, col. 4, line 45 and col. 8, line 50; Falke, col. 1, line 5), and each is directed to particular applications for which such flexible foams are well suited. Also, like Apichatachutapan, both Falke and Lutter contain vast laundry lists of potential candidate species of every kind and description for the various components that can go into polyurethane foams, with no hint or suggestion how, whether or why one can or should prepare all possible combinations of all species for all components. Absolutely no hint or suggestion is to be found in either Falke or Lutter to prepare a semi-rigid foam, particularly using the amounts of propylene oxide extended tipped amine-based polyols as claimed, which has been found surprisingly and unexpectedly to be very well suited to dynamic

impact force attenuation across a broad range of impact speeds. These unexpected results, discussed further above and in the Milliren Declaration, weigh strongly against any finding of obviousness of the present claims over either Lutter or Falke.

Accordingly, it is believed that the present claim rejections now have been overcome, and that the claims are in condition for allowance.

New claim 40 has been added to the application to emphasize certain surprising and unexpected results observed for embodiments of the present foam. Specifically, this claim recites that the foam is an energy absorbing foam capable to provide effective attenuation of dynamic impact forces for impact speeds in the range of 2-6 meters/second, wherein the foam performs comparably to or better than EPS for high speed impacts in this range and better than EPS for low speed impacts in this range. Such performance for a semi-rigid viscoelastic foam is entirely novel and non-obvious over the prior art, and consequently claim 40 is submitted to be independently patentable.

For all the foregoing reasons, it is submitted, respectfully, that the rejections of claims 1, 2, 15, 16 and 32 all have been overcome, and that these claims now are in condition for allowance. In addition, claim 40 is believed also to be independently allowable for reasons explained above. All remaining claims are dependent claims and are submitted as being allowable as such.

If the Examiner has any questions or concerns regarding the instant submission, or otherwise for any reason that may advance prosecution, he is requested to please contact the undersigned attorney at the phone number provided below.

If there are any additional fees resulting from this communication not covered by an enclosed check, please charge same to our Deposit Account No. 16-0820, our Order No. 36211.

Respectfully submitted,
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